

$\Delta(1900) 1/2^-$ $I(J^P) = \frac{3}{2}(\frac{1}{2}^-)$ Status: **

OMITTED FROM SUMMARY TABLE

Some obsolete results published before 1980 were last included in our 2006 edition, Journal of Physics, G **33** 1 (2006). Some further obsolete results published before 1984 were last included in our 2006 edition, Journal of Physics, G **33** 1 (2006).

The latest GWU analysis (ARNDT 06) finds no evidence for this resonance.

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 $\Delta(1900)$ BREIT-WIGNER MASS

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
1840 to 1920 (\approx 1860) OUR ESTIMATE			
1840 \pm 30	ANISOVICH	12A	DPWA Multichannel
1890 \pm 50	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
1908 \pm 30	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1868 \pm 12	SHRESTHA	12A	DPWA Multichannel
1802 \pm 87	VRANA	00	DPWA Multichannel
1920 \pm 24	MANLEY	92	IPWA $\pi N \rightarrow \pi N & N\pi\pi$
1918.5 \pm 23.0	CHEW	80	BPWA $\pi^+ p \rightarrow \pi^+ p$

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→ UNCHECKED ←

 $\Delta(1900)$ BREIT-WIGNER WIDTH

VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
300 to 263 (\approx 234) OUR ESTIMATE			
300 \pm 45	ANISOVICH	12A	DPWA Multichannel
170 \pm 50	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
140 \pm 40	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
234 \pm 27	SHRESTHA	12A	DPWA Multichannel
48 \pm 45	VRANA	00	DPWA Multichannel
263 \pm 39	MANLEY	92	IPWA $\pi N \rightarrow \pi N & N\pi\pi$
93.5 \pm 54.0	CHEW	80	BPWA $\pi^+ p \rightarrow \pi^+ p$

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 $\Delta(1900)$ POLE POSITION

REAL PART VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
1845 to 2029 or 2025			
1845 \pm 25	ANISOVICH	12A	DPWA Multichannel
1780	¹ HOEHLER	93	SPED $\pi N \rightarrow \pi N$
1870 \pm 40	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
1844	SHRESTHA	12A	DPWA Multichannel
1795	VRANA	00	DPWA Multichannel
not seen	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90
2029 or 2025	² LONGACRE	78	IPWA $\pi N \rightarrow N\pi\pi$

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-2xIMAGINARY PART VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
300 to 164 or 163			
300 \pm 45	ANISOVICH	12A	DPWA Multichannel
180 \pm 50	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$
• • • We do not use the following data for averages, fits, limits, etc. • • •			
223	SHRESTHA	12A	DPWA Multichannel
58	VRANA	00	DPWA Multichannel
not seen	ARNDT	91	DPWA $\pi N \rightarrow \pi N$ Soln SM90
164 or 163	² LONGACRE	78	IPWA $\pi N \rightarrow N\pi\pi$

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 $\Delta(1900)$ ELASTIC POLE RESIDUE

MODULUS r VALUE (MeV)	DOCUMENT ID	TECN	COMMENT
10 \pm 3	ANISOVICH	12A	DPWA Multichannel
10 \pm 3	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$

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NODE=B030RER

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PHASE θ

<u>VALUE (°)</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
-125 ± 20	ANISOVICH	12A	DPWA Multichannel
+ 20 ± 40	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$

<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
ANISOVICH	12A	DPWA Multichannel

 $\Delta(1900)$ INELASTIC POLE RESIDUE

The "normalized residue" is the residue divided by $\Gamma_{pole}/2$.

Normalized residue in $N\pi \rightarrow \Delta(1900) \rightarrow \Sigma K$

<u>MODULUS (%)</u>	<u>PHASE (°)</u>
7 ± 2	-50 ± 30

<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
ANISOVICH	12A	DPWA Multichannel

Normalized residue in $N\pi \rightarrow \Delta(1900) \rightarrow \Delta\pi, D\text{-wave}$

<u>MODULUS (%)</u>	<u>PHASE (°)</u>
12 ⁺⁸ ₋₅	110 ± 20

<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>
ANISOVICH	12A	DPWA Multichannel

 $\Delta(1900)$ DECAY MODES

The following branching fractions are our estimates, not fits or averages.

Mode	Fraction (Γ_i/Γ)
$\Gamma_1 N\pi$	10–30 %
$\Gamma_2 \Sigma K$	
$\Gamma_3 N\pi\pi$	
$\Gamma_4 \Delta\pi$	
$\Gamma_5 \Delta(1232)\pi, D\text{-wave}$	
$\Gamma_6 N\rho$	
$\Gamma_7 N\rho, S=1/2, S\text{-wave}$	
$\Gamma_8 N\rho, S=3/2, D\text{-wave}$	
$\Gamma_9 N(1440)\pi, S\text{-wave}$	
$\Gamma_{10} N\gamma, \text{ helicity}=1/2$	

NODE=B030IMR
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NODE=B030240

NODE=B030RS1
NODE=B030RS1

NODE=B030RS2
NODE=B030RS2

NODE=B030225; NODE=B030

NODE=B030

DESIG=1; OUR EST
DESIG=2
DESIG=6
DESIG=7
DESIG=11
DESIG=8
DESIG=12
DESIG=3
DESIG=4
DESIG=5

NODE=B030230

NODE=B030R1
NODE=B030R1

 $\Delta(1900)$ BRANCHING RATIOS

<u>$\Gamma(N\pi)/\Gamma_{\text{total}}$</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	<u>Γ_1/Γ</u>
7 ± 3	ANISOVICH	12A	DPWA Multichannel	
10 ± 3	CUTKOSKY	80	IPWA $\pi N \rightarrow \pi N$	
8 ± 4	HOEHLER	79	IPWA $\pi N \rightarrow \pi N$	
• • • We do not use the following data for averages, fits, limits, etc. • • •				
8 ± 1	SHRESTHA	12A	DPWA Multichannel	
33 ± 10	VRANA	00	DPWA Multichannel	
41 ± 4	MANLEY	92	IPWA $\pi N \rightarrow \pi N & N\pi\pi$	
28	CHEW	80	BPWA $\pi^+ p \rightarrow \pi^+ p$	

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<u>$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1900) \rightarrow \Sigma K$</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	<u>$(\Gamma_1\Gamma_2)^{1/2}/\Gamma$</u>
<0.03	CANDLIN	84	DPWA $\pi^+ p \rightarrow \Sigma^+ K^+$	

NODE=B030R2
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<u>$(\Gamma_i\Gamma_f)^{1/2}/\Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1900) \rightarrow \Delta(1232)\pi, D\text{-wave}$</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	<u>$(\Gamma_1\Gamma_5)^{1/2}/\Gamma$</u>
+0.25 ± 0.07	MANLEY	92	IPWA $\pi N \rightarrow \pi N & N\pi\pi$	
• • • We do not use the following data for averages, fits, limits, etc. • • •				

NODE=B030R11
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<u>$\Gamma(\Delta(1232)\pi, D\text{-wave})/\Gamma_{\text{total}}$</u>	<u>DOCUMENT ID</u>	<u>TECN</u>	<u>COMMENT</u>	<u>Γ_5/Γ</u>
15 ⁺⁵⁰ ₋₁₀	ANISOVICH	12A	DPWA Multichannel	
28 ± 1	VRANA	00	DPWA Multichannel	
• • • We do not use the following data for averages, fits, limits, etc. • • •				
56 ± 6	SHRESTHA	12A	DPWA Multichannel	

NODE=B030R7
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$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1900) \rightarrow N\rho, S=1/2, S\text{-wave}$	$(\Gamma_1 \Gamma_7)^{1/2} / \Gamma$		
VALUE	DOCUMENT ID	TECN	COMMENT
$\bullet \bullet \bullet$ We do not use the following data for averages, fits, limits, etc. $\bullet \bullet \bullet$			
-0.14 ± 0.11	MANLEY 92	IPWA	$\pi N \rightarrow \pi N$ & $N\pi\pi$

NODE=B030R12
NODE=B030R12

$\Gamma(N\rho, S=1/2, S\text{-wave}) / \Gamma_{\text{total}}$	Γ_7 / Γ		
VALUE (%)	DOCUMENT ID	TECN	COMMENT
$\bullet \bullet \bullet$ We do not use the following data for averages, fits, limits, etc. $\bullet \bullet \bullet$			
30 ± 2	VRANA 00	DPWA	Multichannel

NODE=B030R5
NODE=B030R5

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1900) \rightarrow N\rho, S=3/2, D\text{-wave}$	$(\Gamma_1 \Gamma_8)^{1/2} / \Gamma$		
VALUE	DOCUMENT ID	TECN	COMMENT
$\bullet \bullet \bullet$ We do not use the following data for averages, fits, limits, etc. $\bullet \bullet \bullet$			
-0.37 ± 0.07	MANLEY 92	IPWA	$\pi N \rightarrow \pi N$ & $N\pi\pi$

NODE=B030R3
NODE=B030R3

$\Gamma(N\rho, S=3/2, D\text{-wave}) / \Gamma_{\text{total}}$	Γ_8 / Γ		
VALUE (%)	DOCUMENT ID	TECN	COMMENT
$\bullet \bullet \bullet$ We do not use the following data for averages, fits, limits, etc. $\bullet \bullet \bullet$			
5 ± 1	VRANA 00	DPWA	Multichannel

NODE=B030R6
NODE=B030R6

$(\Gamma_i \Gamma_f)^{1/2} / \Gamma_{\text{total}}$ in $N\pi \rightarrow \Delta(1900) \rightarrow N(1440)\pi, S\text{-wave}$	$(\Gamma_1 \Gamma_9)^{1/2} / \Gamma$		
VALUE	DOCUMENT ID	TECN	COMMENT
$\bullet \bullet \bullet$ We do not use the following data for averages, fits, limits, etc. $\bullet \bullet \bullet$			
-0.16 ± 0.11	MANLEY 92	IPWA	$\pi N \rightarrow \pi N$ & $N\pi\pi$

NODE=B030R4
NODE=B030R4

$\Gamma(N(1440)\pi, S\text{-wave}) / \Gamma_{\text{total}}$	Γ_9 / Γ		
VALUE (%)	DOCUMENT ID	TECN	COMMENT
$\bullet \bullet \bullet$ We do not use the following data for averages, fits, limits, etc. $\bullet \bullet \bullet$			
<1	SHRESTHA 12A	DPWA	Multichannel

NODE=B030R8
NODE=B030R8

$\Delta(1900)$ PHOTON DECAY AMPLITUDES

Papers on γN amplitudes predating 1981 may be found in our 2006 edition, Journal of Physics, G **33** 1 (2006).

$\Delta(1900) \rightarrow N\gamma$, helicity-1/2 amplitude $A_{1/2}$

VALUE ($\text{GeV}^{-1/2}$)	DOCUMENT ID	TECN	COMMENT
0.059 ± 0.016	³ ANISOVICH 12A	DPWA	Phase = $(60 \pm 25)^\circ$
-0.004 ± 0.016	CRAWFORD 83	IPWA	$\gamma N \rightarrow \pi N$
0.029 ± 0.008	AWAJI 81	DPWA	$\gamma N \rightarrow \pi N$
$\bullet \bullet \bullet$ We do not use the following data for averages, fits, limits, etc. $\bullet \bullet \bullet$			
-0.082 ± 0.009	SHRESTHA 12A	DPWA	Multichannel

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NODE=B030A1
NODE=B030A1

$\Delta(1900)$ FOOTNOTES

¹ See HOEHLER 93 for a detailed discussion of the evidence for and the pole parameters of N and Δ resonances as determined from Argand diagrams of πN elastic partial-wave amplitudes and from plots of the speeds with which the amplitudes traverse the diagrams.

² LONGACRE 78 values are from a search for poles in the unitarized T-matrix. The first (second) value uses, in addition to $\pi N \rightarrow N\pi\pi$ data, elastic amplitudes from a Saclay (CERN) partial-wave analysis.

³ This ANISOVICH 12A value is the complex helicity amplitude at the pole position.

NODE=B030

NODE=B010;LINKAGE=H9

NODE=B030;LINKAGE=L8

NODE=B030A1;LINKAGE=AN

Δ(1900) REFERENCES

For early references, see Physics Letters **111B** 1 (1982).

ANISOVICH	12A	EPJ A48 15	A.V. Anisovich <i>et al.</i>	(BONN, PNPI)	REFID=54041
SHRESTHA	12A	PR C86 055203	M. Shrestha, D.M. Manley	(KSU)	REFID=54862
ARNDT	06	PR C74 045205	R.A. Arndt <i>et al.</i>	(GWU)	REFID=51535
PDG	06	JPG 33 1	W.-M. Yao <i>et al.</i>	(PDG Collab.)	REFID=51004
VRANA	00	PRPL 328 181	T.P. Vrana, S.A. Dytman,, T.-S.H. Lee	(PITT+)	REFID=47593
HOEHLER	93	πN Newsletter 9 1	G. Hohler	(KARL)	REFID=43821
MANLEY	92	PR D45 4002	D.M. Manley, E.M. Saleski	(KSA) IJP	REFID=41535
Also		PR D30 904	D.M. Manley <i>et al.</i>	(VPI)	REFID=30071
ARNDT	91	PR D43 2131	R.A. Arndt <i>et al.</i>	(VPI, TELE) IJP	REFID=41467
CANDLIN	84	NP B238 477	D.J. Candlin <i>et al.</i>	(EDIN, RAL, LOWC)	REFID=40339
CRAWFORD	83	NP B211 1	R.L. Crawford, W.T. Morton	(GLAS)	REFID=30070
AWAJI	81	Bonn Conf. 352	N. Awaji, R. Kajikawa	(NAGO)	REFID=30067
Also		NP B197 365	K. Fujii <i>et al.</i>	(NAGO)	REFID=30068
CHEW	80	Toronto Conf. 123	D.M. Chew	(LBL) IJP	REFID=31151
CUTKOSKY	80	Toronto Conf. 19	R.E. Cutkosky <i>et al.</i>	(CMU, LBL) IJP	REFID=30064
Also		PR D20 2839	R.E. Cutkosky <i>et al.</i>	(CMU, LBL) IJP	REFID=40096
HOEHLER	79	PDAT 12-1	G. Hohler <i>et al.</i>	(KARLT) IJP	REFID=30058
Also		Toronto Conf. 3	R. Koch	(KARLT) IJP	REFID=30859
LONGACRE	78	PR D17 1795	R.S. Longacre <i>et al.</i>	(LBL, SLAC)	REFID=30054

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